DOCUMENT RESUME

ED 103 355 SP 008 960

AUTHOR Smith, Patrick E.
TITLE The Influence of Four Instructional Components on Concept Acquisition.
PUB DATE 75
NOTE 8p.; Paper presented at the Annual Meeting of the American Educational Research Association (Washington, D.C., 1975)

EDRS PRICE MF-$0.76 HC-$1.58 PLUS POSTAGE
DESCRIPTORS *Activity Learning; *Concept Formation; *Conceptual Schemes; *Feedback; Graduate Students; Learning Activities; Learning Processes; Research Projects; *Teacher Education; Teaching Methods; Teaching Techniques

ABSTRACT

This study examined effects of five combinations of four instructional variables on student learning. Subjects were 168 graduate students ernolled in a course in educational research at Arizona State University, Tempe. The five versions of the instructional program used in this study were constructed from cues, examples, practice items, and feedback. Cues provided a definition of the concept to be acquired, and examples consisted of one positive and one negative instance of the concept class. Practice items presented the name of a concept class and four instances of the class for subjects to classify. Feedback combined instructional feedback and knowledge of correct response. Subjects were given a packet containing the instructional material appropriate to one of the experimental groups; after studying the material, the student was given a 60-item posttest. The study indicates that of the four instructional components investigated, practice and feedback contributed the most to subject acquisition of concepts presented. (MJM)

# THE INFLUENCE OF FOUR INSTRUCTIONAL COMPONENTS ON CONCEPT ACQUISITION[1]

Patrick E. Smith
Maricopa County Community College District

Objectives. An analysis of the concept learning literature reveals four factors which are regarded as important in student attainment of a concept. One such factor is the information the learner typically needs at the beginning of instruction in order to perform a behavior indicated in an instructional objective. This information may be presented in the form of a definition, a rule, or a set of procedures, and is termed an instructional cue (Sullivan, Baker & Schutz, 1971). Another variable which is important during instruction is selected concept examples. The use of examples in instruction exposes the student to specific instances of the concept class, a procedure which researchers of concept teaching have strongly recommended (Englemann, 1969; Markle & Tiemann, 1969, 1972). Practice is also an important instructional variable. Popham (1969) contends that curricular materials should contain practice items which provide the student with opportunities to engage in behaviors relevant to the desired concept to be mastered. Providing students with feedback after a response is a fourth variable considered by several reviewers (Anderson, 1967; Higgins, 1972) to be important for effective instruction. These four factors may be regarded as key elements of well designed instruction.

To date the effects of instructional cues, examples, practice activities, and feedback on concept acquisition have been investigated and reported independently. The comparative importance of each factor in concept attainment and the relationship of these factors to each other in a systematically designed instructional program have not been investigated. It seems probable that when these four variables are systematically added to instruction, a corresponding improvement in concept acquisition should result.

The purpose of this study was to determine the effects of five combinations of four instructional variables on student learning. The five combinations investigated were Cues Only (C), Cues-Examples (CE), Cues-Practice (CP), Cues-Examples-Practice (CEP), and Cues-Examples-Practice-Feedback (CEPF). Each instructional variable combination was presented in a separate program version. The effects of the instructional variable combinations were considered both individually and additively.

Method. Subjects were 168 graduate students enrolled in a course in educational research at Arizona State University.

The instructional material used in this experiment was a programmed sequence entitled Classifying and Interpreting Education Research Studies (Sullivan, 1970). This program was designed to teach six basic concepts for use in analyzing educational research. The program objectives required subjects to name the types of studies and to identify permissible statements of research conclusions.

---

[1]Paper presented at the Annual Meeting of the American Educational Research Association, Washington, D.C., 1975.

The five versions of the instructional program used in this study were constructed from cues, examples, practice items, and feedback. Cues provided a definition of the concept to be acquired and the examples consisted of one positive and one negative instance of the concept class. Practice items presented the name of a concept class and four instances of the class for subjects to classify. Feedback combined instructional feedback (IFB) and knowledge of correct response (KCR). IFB consisted of the correct response and an explanation of why the response was correct. IFB was provided after the first negative and the first positive instance of the concept class included in each practice item. KCR indicated only the correct response and was provided after all other instances. A control group received a posttest and then read irrelevant material.

As each subject entered his classroom, he was given a packet containing the instructional material appropriate to one of the experimental groups. The packets were randomized within groups of six, one packet from each treatment condition, prior to distribution. Subjects were told to read and study the material in a manner consistent with their usual practice. After studying the material, each subject raised his hand and was given the posttest.

A 60-item posttest was used to measure the effects of the various treatments. The posttest was divided into six subtest sections, one section for each of the six concepts presented in the instruction. Each subtest consisted of ten items and contained previously unencountered positive and negative instances of the concept presented in the instruction.

Results. Table 1 shows the posttest mean scores for each treatment group on each of the six subtests and on the total test. These data were analyzed using Page's (1963) L-test to determine if a monotonic relationship existed between the predicted and observed posttest performance by treatment. The L-test indicated that there was significant agreement between the predicted and observed rankings of the subtest mean scores for the six treatment groups ($L = 526$, $p < .01$). Table 2 contains the data for this analysis. As predicted, the performance of the CEPF group was consistently high on the six subtest sections while the performance of the Control group was consistently low. The performance of the four other groups fell into the mid-range on the subtests and not in the exact order predicted.

The L-test indicates whether or not a significant trend in posttest mean scores occurs in the predicted order of performance, but does not reveal whether significant differences in posttest performance exist between the individual treatment groups. To determine if there were significant differences between the posttest mean scores of the treatment groups, a one-way analysis of variance of posttest mean scores was performed. This analysis yielded an overall significant difference ($F = 9.70$, $df = 5/167$, $p < .01$) for the six treatment groups.

A Scheffé test of between-group differences revealed that on the posttest the mean score of 48.32 for the group receiving all four instructional components (CEPF) was significantly higher ($p < .01$) than the posttest scores obtained by all other groups. The Scheffé test also indicated that the three treatment groups receiving practice, the CEPF, CEP, and CP groups, scored significantly higher ($p < .01$) than the Control group but not significantly higher than the Cues-Examples and Cues Only groups. No other differences between groups were statistically significant.

There were large differences between groups in the number of errors made on the 68 practice items included in the instructional material. The CEPF group made only 5.43

errors whereas the CEP group made 19.46 errors and the CP group made 21.25 errors. Thus, the two groups receiving practice but no feedback (CP and CEP) made between three and four times as many in-program errors as the group receiving both practice and feedback. A one-way analysis of variance indicated that the differences in practice errors were significant ($F = 49.23$, $df = 2/83$, $p < .01$). The Scheffé test revealed that both the CP and CEP groups made significantly more errors ($p < .01$) than the CEPF group. The number of errors for the CP and CEP groups did not differ significantly.

Time required to complete the instructional program was recorded and analyzed for all subjects. Each of the three groups receiving practice took over 37 minutes to complete their material, whereas the two no-practice groups took 16 minutes and 21.46 minutes. A one-way analysis of variance of completion times yielded a significant difference ($F = 53.68$, $df = 4/139$, $p < .01$). A Scheffé test indicated that each of the three groups receiving practice took significantly more time to complete their programs ($p < .01$) than did the two groups not receiving practice. The test also indicated that the group which received examples with cues (CE) took significantly longer to complete the program ($p < .01$) than did the group which received cues only. No other differences for time on instruction were significant.

Discussion. A comparison of posttest scores from each of the five treatment groups indicated that when each instructional component was combined with the instruction, increases in posttest performances occurred. An L-test revealed a significant relationship between the predicted and observed posttest performance for the five groups. However, the overall trend in posttest scores was not exactly as predicted because subjects who received the material containing only cues and practice items obtained higher posttest scores than subjects who received cues, examples, and practice items. The most effective combination of variables was the one which included all four instructional variables: cues, examples, practice, and feedback.

Subjects studying material containing cues, examples, practice items, and feedback received significantly higher scores on the posttest than subjects studying the same instruction without feedback. The effectiveness of the CEPF treatment was largely attributable to including feedback with practice. Two kinds of feedback were included in the instructional program. IFB (instructional feedback) was presented following practice on the first example and nonexample of the concept and KCR (knowledge of correct response) was presented following all other practice items. One reason that feedback may have been effective was that the combination of IFB and KCR provided the subject with more complete feedback (IFB) at the time when the response presumably was being acquired and with a briefer form of feedback (KCR) when the response was being maintained. The IFB in the CEPF condition constituted the second presentation of the information needed by the subject to make a correct response since the information was presented initially as an instructional cue.

Subjects receiving practice items without feedback made significantly more errors (CP, 21.25; CEP, 19.46) within their programs than subjects receiving both practice items and feedback (CEPF, 5.43). Clearly, the feedback in the CEPF material had a strong effect on the number of errors made on practice items. However, it is not clear how subjects used feedback during practice. Since IFB was presented immediately after each set of four practice items, subjects had two additional opportunities to study the information which explained why a given response was correct. In addition to IFB, all feedback messages contained KCR. Therefore, it is possible that subjects in the CEPF group used the feedback information to determine the correct response before responding, rather than after responding. Regardless of the manner in which feedback was used during practice, feedback had a significant effect on the posttest performance of the CEPF group.

The amount of time which subjects took to complete the program increased as the number of instructional components in the particular program version increased. Groups receiving practice items took significantly more time to read their programs than groups not receiving practice, but they also obtained higher scores on the posttest. However, the presence of feedback in the CEPF program did not significantly increase subject study time over the CEP program, but it did significantly increase posttest scores.

This study indicates that of the four instructional components investigated, practice and feedback contributed the most to subject acquisition of the concepts presented. These results are in contrast with recent research (Tenpas and Higgins, 1974; Tenpas, Reiser, Kearns, Booth & Deden, 1974) which found that cues and examples, rather than practice or feedback, made the major contribution to subject posttest performance. The apparent inconsistency between the results of this research and the Tenpas and Higgins findings may be related to the nature of the instructional task or the way in which concepts were presented in the instruction. In the Tenpas research, the instruction for an aircraft instrument comprehension task consisted of new applications for familiar concepts which were presented both visually and verbally. For this task, a cue and several examples were sufficient for the subject to acquire the new concepts. In contrast, when the instructional task consisted of learning a new concept and classifying new instances of the concept, such as in the present study, cues and examples were not effective. However, when practice and feedback components were added to the instruction, subjects performed the classification task significantly better. It seems likely that practice and feedback become more effective in facilitating concept acquisition when the subject must learn both new terminology related to the concept and application of the concept, rather than just learning to apply new concepts based on familiar terminology.

One important finding from the results of the present study was the cumulative effect that combining cues, examples, practice items, and feedback had on learning new concepts and their applications. However, it appears from the present research and from earlier findings that the individual effects of these four instructional components may vary with the type of task. The necessary information and skill for some instructional tasks is apparently acquired prior to receiving practice and feedback. In such cases, practice and feedback have little potential for improving the subject's acquisition of the concept. However, in cases such as the present study when instruction does not enable the subject to acquire and apply the concept, practice and feedback may result in improved acquisition of the concept. Research involving different types of learning tasks should help to indicate the extent to which the effects of feedback and practice are specific to particular types of tasks.

TABLE 1

POSTTEST MEAN SCORES BY TREATMENT AND SUBTEST

| Treatment | Subtest Section | | | | | | Total |
|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | |
| Control | 4.18 | 6.54 | 4.71 | 6.32 | 6.39 | 6.00 | 34.14 |
| Cues | 5.43 | 7.75 | 4.96 | 7.36 | 6.68 | 6.11 | 38.29 |
| Cues-Examples | 6.39 | 7.14 | 5.57 | 5.97 | 6.72 | 6.39 | 38.18 |
| Cues-Practice | 5.96 | 8.57 | 5.32 | 7.61 | 7.68 | 7.25 | 42.39 |
| Cues-Examples-Practice | 6.21 | 8.29 | 5.29 | 7.21 | 7.36 | 6.46 | 40.82 |
| Cues-Examples-Practice-Feedback | 7.18 | 9.18 | 7.14 | 8.86 | 8.78 | 7.18 | 48.32 |

TABLE 2

L-TEST SUMMARY TABLE FOR POSTTEST SCORES
BY TREATMENT AND SUBTEST

| Subtest Section | Treatment | | | | | | |
|---|---|---|---|---|---|---|---|
| | CEPF | CEP | CP | CE | C | Control | |
| | 1 | 2 | 3 | 4 | 5 | 6 | |
| 1 | 1 | 3 | 4 | 2 | 5 | 6 | |
| 2 | 1 | 3 | 2 | 5 | 4 | 6 | |
| 3 | 1 | 4 | 3 | 2 | 5 | 6 | |
| 4 | 1 | 4 | 2 | 6 | 3 | 5 | |
| 5 | 1 | 3 | 2 | 4 | 5 | 6 | |
| 6 | 2 | 3 | 1 | 4 | 5 | 6 | |
| Sum | 7 | 20 | 14 | 23 | 27 | 35 | |
| Sum :: Rank | 7 | 40 | 42 | 92 | 135 | 210 = | 526* |

* L = 526, p <.01

Note.--The treatments are arranged from left to right across the columns of the tabke in their order of predicted effect on posttest performance. For example, the CEPF group is in the far left column because it was expected to yield the highest performance. The rows of the table represent the subtest sections. Entries in each cell under a treatment group show the observed rank order of performance of that group on the subtest section represented by that cell. Thus, it can be seen that the CEPF group ranked highest of any group (a rank of 1) on subtest sections 1-5 and second highest on section 6.